NASA Procedural Requirements

COMPLIANCE IS MANDATORY

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Appendix A. Definitions

A.1 Casualty: An injury requiring overnight hospitalization or worse, including death. For the purpose of casualty modeling, any injury that, due to its severity, qualifies as a Level-3, 4, 5, or 6 injury per the Abbreviated Injury Scale (AIS), Association for the Advancement of Automotive Medicine, would be counted as a casualty.

A.2 Certificate of Authorization or Waiver: A Certificate of Authorization or Waiver constitutes relief by the FAA from specific regulations for the period of time specified on the certificate. The FAA will issue Certificates of Authorization or Waiver only to public (e.g., a university) or Government organizations. The Certificate of Authorization or Waiver will specify the operations that are permitted, define the area where the operations may be conducted, and specify altitudes at which they may be conducted.

A.3 Collective Risk: The total combined risk to all individuals exposed to one or more particular hazards during a specific period of time or event (a specific phase of flight). Unless otherwise noted, collective risk for a range operation is the mean number of casualties expected (Ec) during an established period or event (e.g., a launch) due to the combination of all hazards associated with the operation.

A.4 Commercial Launch: A service supplied by the private sector that provides the capability of placing a vehicle and any payload into a suborbital trajectory, Earth orbit, or into outer space.

A.5 Containment: A range safety technique that precludes hazards from reaching the public, the workforce, or property that requires protection during normal and malfunctioning vehicle flight.

A.6 Contingency Management System: A system designed to manage the vehicle

throughout the atmospheric flight envelope that provides a controlled response under the full set of circumstances defined by the mission's risk assessment. The system may be comprised of a set of elements within the vehicle, including but not limited to, manual control, autonomous control, and recovery capability.

A.7 Critical Operations Personnel: Critical Operations Personnel include persons not essential to the specific operation (launch, entry, flight) currently being conducted, but who are required to perform safety, security, or other critical tasks at the launch, landing, or flight facility. Critical Operations Personnel are notified of the hazardous operation and either trained in mitigation techniques or accompanied by a properly trained escort. Critical Operations Personnel do not include individuals in training for any job or individuals performing routine activities such as administrative, maintenance, or janitorial. Critical Operations Personnel may occupy safety clearance zones and hazardous areas and need not be evacuated with the public. Critical Operations Personnel are included in the same risk category as Mission Essential Personnel.

A.8 Emergency Response Planning Guidelines (ERPG) - Level 2: The ERPG - Level 2 is the maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair an individual's ability to take protective action.

A.9 Entry Operation: The sequence of controlled thrust maneuvers or other events that brings a space vehicle or spacecraft from Earth orbit or outer space to Earth. Entry operations do not include suborbital flights.

A.10 Equivalent Level of Safety (ELS) (determination): The approval of an alternative approach to satisfying a range safety requirement where the alternative provides an approximately equal level of safety as determined by qualitative or quantitative means (see paragraph 1.5 of this NPR).

A.11 Expectation of Casualty (Ec): The average number of casualties expected per an event, such as vehicle flight, if a large number of events could be carried out under identical circumstances.

A.12 Expendable Launch Vehicle: A vehicle that, once launched, is not reused and typically is not retrieved.

A.13 Explosive Debris: Solid propellant fragments or other pieces of a launch or entry vehicle or payload that result from breakup of the vehicle during flight and that explode upon impact with the Earth’s surface or on their own and cause overpressure.

A.14 Flight: Launch or entry of an orbital or suborbital space vehicle/spacecraft or operation of an aeronautical vehicle. For the purposes of this NPR, “flight” does not include on-orbit operations.

A.15 Flight Termination System (FTS): A type of range safety system designed, tested, and incorporated into vehicles that provides for the independent and deliberate termination of an errant/erratic vehicle’s flight.

A.16 FTS Command System: All components needed to send a flight termination command signal to an onboard vehicle flight termination system. An FTS command system starts with flight termination activation switches and ends at each command-transmitting antenna. It includes all intermediate equipment linkages, software, and auxiliary transmitters that ensure a command signal will reach the onboard

vehicle flight termination system during flight.

A.17 Hazard: A state or condition that could potentially lead to an undesirable consequence (i.e., casualty or property damage).

A.18 Hazard Area: A defined region of land, water, or airspace within which hazards exist or have the potential to exist during a range operation such that the risks associated with the hazards may be mitigated by controlling access to the defined region.

A.19 Individual Risk: The probability of an individual from a certain group (or subgroup) at a specific location suffering a casualty from exposure to a given event during an established period (e.g., a launch). Individual risk is stated as a Probability of Casualty (Pc).

A.20 Landing Site: The location on which a vehicle impacts, lands, or is recovered.

A.21 Launch: To place a vehicle and any payload from Earth in a suborbital trajectory, in Earth orbit, or in outer space. For an orbital mission, launch begins with lift-off and ends with orbital insertion. For a suborbital mission, launch begins with lift-off and ends with landing/final impact of all vehicle components.

A.22 Launch Site: The location from which a launch takes place. This includes land, air, or a sea-based position.

A.23 Mishap: Any unplanned event or series of events that results in death, injury, occupational illness, or damage to or loss of property.

A.24 Mission Essential Personnel: Government or contractor personnel who are directly involved in ensuring the safety and success of a mission. For the purposes of range safety, mission essential personnel do not include any people on board the vehicle.

A.25 NASA Launch: A launch conducted by or for NASA, where NASA is so substantially involved that it effectively directs or controls the activity.

A.26 National Airspace System: The common network of U.S. airspace controlled by the FAA including air navigation facilities, equipment and services, airports or landing areas, aeronautical charts, information and services, rules, regulations, and procedures, technical information, and manpower and material. Also included are system components shared jointly with the military.

A.27 Orbital Insertion: With regard to the application of requirements and criteria in this NPR to a space launch, orbital insertion occurs when the vehicle or component achieves a minimum 70 nm perigee based on a computation that accounts for drag.

A.28 Payload: The object(s) within a payload fairing carried or delivered by a vehicle to a desired location or orbit.

A.29 Probability of Casualty (Pc): A measure of individual risk. Pc is the probability that an individual at a specific location would be a casualty per an event, such as vehicle flight, if a large number of events could be carried out under identical circumstances. For example, if an individual would be a casualty once per one million identical launches, the Pc for such a launch would be 1´10-6.

A.30 Probability of Impact: The probability that one or more pieces of debris from a vehicle will impact a given location or object (e.g., aircraft, ships).

A.31 Property: In the context of this NPR, the term property is intended in the broadest sense. Property includes, but is not limited to public or privately owned land/real estate, homes, factories, livestock, natural resources, facilities, equipment, and other assets (including those on or off a range or launch or landing site). Local authorities and programs are responsible for identifying property that requires protection per paragraph 3.2.4.3.b of this NPR. In general, the range safety function to protect property does not include protection of the vehicle or payload being flown in a range operation.

A.32 Public: For the purposes of range safety risk management, all people who are not Critical Operations Personnel or Mission Essential Personnel. Public includes visitors and personnel inside and outside NASA-controlled locations who are not Critical Operations Personnel or Mission Essential Personnel and who may be on land, on waterborne vessels, or in aircraft.

A.33 Range: A permanent or temporary area or volume of land, sea, or airspace within or over which orbital, suborbital, or atmospheric vehicles are tested or flown. This includes the operation of launch vehicles from a launch site to orbital insertion or final landing or impact of suborbital vehicle components. This also includes the entry of space vehicles from the point that the commit to deorbit is initiated to the point of intact vehicle impact or landing or the impact of all associated debris. This includes range operations with aeronautical vehicles from takeoff to landing.

A.34 Range Operation: The flight of a launch or entry vehicle or experimental aeronautical vehicle including any payload, at, to, or from a range, launch site, or landing site. Range operations utilize specific infrastructure as well as trained and certified human interfaces to monitor, command, and control the range safety elements associated with programs. Range operations do not include the flight of conventional piloted aircraft unless specific aspects of the operation require range safety involvement to protect the public, workforce, and/or property. Range operations do not include on orbit operations of vehicles after orbital insertion or prior to initiation of entry.

A.35 Range Operator: A range operator is either a NASA, DoD, commercial, or foreign entity responsible for providing the ground, sea, air, or space-based assets required to support range operations.

A.36 Range Safety: Application of safety policies, principles, and techniques to protect the public, workforce, and/or property from hazards associated with range operations.

A.37 Range Safety Officer (RSO): A person responsible for safety during a range operation. An RSO has the authority to hold or abort the operation, or take a risk mitigation action, which includes terminating the flight. RSO is synonymous with the term Mission Flight Control Officer used at some DoD ranges.

A.38 Range Safety Organization: An organization that reports to the safety authority for range operations, oversees the implementation of range safety requirements, and may provide range safety-related services and operational support to vehicle programs.

A.39 Range Flight Safety Program: A program implemented to ensure that the risk to the public, workforce, and property during range operations is effectively managed.

A.40 Range Safety System(s): A system (including any subsystem) whose performance is factored into the range safety analysis and relied upon during flight to mitigate hazards. These systems include range safety displays, range clearance capability, radar, optic tracking systems, telemetry, tracking display systems (including

instantaneous impact predictors), contingency management systems, flight termination systems, and command and control capability for flight termination systems.

A.41 Range Safety Waiver: A written authorization allowing a range operation to continue even though a specific range safety requirement is not satisfied and the vehicle program is not able to demonstrate an equivalent level of safety. A Range Safety Waiver involves the formal acceptance of increased safety risk by appropriate authorities.

A.42 Range User: A range user is considered a flight test or launch and/or entry vehicle program that conducts range operations on a range.

A.43 Recovery System: A system that is installed on a flight test, launch, or entry vehicle that may be activated when the vehicle has malfunctioned and cannot be recovered under its own capacity. For example, the system may deploy a parachute, extend landing gear, or move flight control surfaces in the attempt to reduce the impact of the vehicle with the ground. Recovery systems are intended to preserve the vehicle and do not necessarily address range safety concerns.

A.44 Reusable Launch Vehicle: Experimental or operational space launch vehicle that is intended to be reused (at least in part).

A.45 Risk: The baseline definition for risk is the product of (1) the probability (qualitative or quantitative) that a program will experience an undesired event such as cost overrun, schedule slippage, safety mishap, or failure to achieve a needed technological breakthrough; and (2) the consequences, impact, or severity of the undesired event were it to occur. For range safety, risk is expressed as casualty expectation, which is a measure that takes into consideration both the probability of occurrence and the consequence of a hazard or combination of hazards to a population or installation. Risk is measured in the same units as the consequence, such as number of injuries, fatalities, or dollar loss.

A.46 Secure Flight Termination System: National Security Agency approved cryptography incorporated into the operations center and vehicle that provides a capability for the secure or authenticated transmissions of a flight termination command or the activation of the FTS.

A.47 Space Launch Vehicles: Operational or experimental vehicles that are launched into orbital or suborbital flights for the purpose of carrying payloads to and from space or demonstrating technologies to further access to space. These vehicles are either inhabited or uninhabited (i.e., ELV, Space Shuttle or equivalent) and may travel at speeds ranging from subsonic to hypersonic.

A.48 Tailoring: The process where the authorities responsible for range safety requirements and a range user review each requirement and jointly document whether the requirement is applicable to the range user's planned operations and, if it is applicable, document whether the range user will meet the requirement as written or achieve an equivalent level of safety through an acceptable alternative. Tailoring includes ELS determinations. Tailoring does not include the approval of Range Safety Waivers, which are addressed by a separate process.

A.49 Unmanned Aircraft Systems (UAS): A UAS includes an Unmanned Aerial Vehicle (UAV) or similar vehicle and all the associated support equipment, control station, data links, telemetry, communications and navigation equipment necessary to operate the vehicle

A.50 Unmanned Aerial Vehicle (UAV): A vehicle that is controlled remotely or that is autonomous and operates at speeds ranging from subsonic to hypersonic in a manner consistent with a "conventional" aircraft. A UAV may be launched from the ground or dropped from other aerial vehicles, subscale flight test vehicles, or lifting bodies. A UAV may also be referred to using a different name such as Uninhabited Air Vehicle, Unmanned Aircraft, Drone, Remotely Piloted Aircraft, Remotely Operated Aircraft, or Remotely Piloted Vehicle. Model aircraft (normally vehicles of less than 55 lbs gross weight flown under manual control within unaided visual contact range) when flown for nongovernmental, recreational purposes are not considered UAVs.

A.51 Workforce: Government or contractor personnel who are directly involved in a range operation or who work at a range, launch site, or landing site where a NASA range operation takes place. For the purposes of this NPR, “workforce” does not include any crew on board a vehicle during flight.

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